PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 155100.1 DAB	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/IL2004/000730	International filing date *(day/month/year)* 05.08.2004	Priority date *(day/month/year)* 06.08.2003
International Patent Classification (IPC) or national classification and IPC G11B7/007		
Applicant MEMPILE INC et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 8 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 11 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☒ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☒	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☒	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand 05.06.2005	Date of completion of this report 09.11.2005
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IL2004/000730

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages	
1, 2, 4-11, 13-19, 21-26	as originally filed
12	filed with telefax on 05.06.2005
3, 3a, 3b, 20	filed with telefax on 26.09.2005
Claims, Numbers	
1-38	filed with telefax on 26.09.2005
Drawings, Sheets	
1/29-29/29	as originally filed

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☒ the claims, Nos. 6
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 6

because:

☒ the said international application, or the said claims Nos. 6 relate to the following subject matter which does not require an international preliminary examination (specify):

see separate sheet

☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. are so unclear that no meaningful opinion could be formed *(specify)*:

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos.

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form
- ☐ has not been furnished
- ☐ does not comply with the standard

the computer readable form
- ☐ has not been furnished
- ☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See separate sheet for further details

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	4,5,7-19,21-38
	No:	Claims	1-3,20
Inventive step (IS)	Yes:	Claims	4,5,12, 13, 18, 19, 37, 38
	No:	Claims	1-3,7-11,14-17,20-36
Industrial applicability (IA)	Yes:	Claims	1-38
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. Claim 6 presently on file has been amended by introducing the feature "for each subsequent data layer L (2<= L <= M), focusing the reading head in controlled registration with a previous data layer (L - 1) and writing data to said data layer (L) so as to, be displaced from the previous data layer (L - 1) by said controlled offset". This feature goes beyond the disclosure of the application as originally filed.
Claim 6 is therefore disregarded for the statement under Item V (Rule 70(2)(c) PCT).

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following document:

   D1: US-B1-6 574 174 (NISHIMURA SHUNICHI ET AL) 3 June 2003 (2003-06-03)
   D2: WO 97/23872 A (THOMSON CSF ; LE CARVENNEC FRANCOIS (FR); HUIGNARD JEAN PIERRE (FR); P) 3 July 1997 (1997-07-03)
   D5: US-A-6 122 133 (NAZARIAN ARA W ET AL) 19 September 2000 (2000-09-19)

2. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-3, 20 is not new in the sense of Article 33(2) PCT and further the subject-matter of claims 7-11,14-17,21-36 does not involve an inventive step in the sense of Article 33(3) PCT.

2.1 As for independent claim 1 the document D2 discloses (the references in parentheses applying to this document):
A formatted optical medium (figs 2a, 3b, and 4a - 5 and corresponding description) having a formatting pattern (fig. 2b with p 3 l 32 - p 4 l 13; fig. 5 p 5 l 27 - p 6 l 16) including registration marks (figs. 2b and 5 m1, m2 and 7, 8) for enabling data to be written to or read from a desired location (cf. fig. 2a 'information de guidage' 4) in a monolithic bulk (2) of the optical medium, said registration marks being arranged in at

least one base layer (S1,S2,S3); wherein the at least one base layer (S1,S2,S3) is formed within a bulk (2) of the optical medium displaced from an outer surface thereof.

The subject-matter of claim 1 is therefore not new in the sense of Article 33(2) PCT.

2.2 As for claim 2 D2 further discloses that when in use, the at least one base layer serves as a guide (4) for writing data at respective data layers in the medium associated with the at least one base layer without requiring pre-formatting of said data layers (p 3 l 20-31).

The subject-matter of claim 2 is therefore not new in the sense of Article 33(2) PCT.

2.3 As for claim 3 D2 further discloses that wherein respective registration marks are contained in multiple base layers (S1,S2,S3) all formed within a bulk of the optical medium displaced from an outer surface thereof, such that adjacent base layers have a known mutual separation and each base layer in use, serves as a guide for writing data at respective multiple data layers in the medium associated with the respective base layers (p 3 l 20-31).

The subject-matter of claim 3 is therefore not new in the sense of Article 33(2) PCT.

2.4 The combination of the features of dependent claims 4 respectively 5 is neither known from, nor rendered obvious by, the available prior art.

The reasons are as follows:

The purpose is to code additional information (cf description p 12-13). None of the available prior art discloses nor renders obvious such a combination of features.

The subject-matter of claims 4 respectively 5 is thus considered both novel and inventive (Art 33(2) and (3) PCT).

This applies mutatis mutandis to claims 12, 13, 18, 19, 37, 38.

2.5 The formatter stipulated in claim 7 is considered to be implicitly disclosed by D2 seen the disclosure of the formatted optical medium (PCT Guidelines 12.01 and 12.04). The feature of a controller for controlling fluctuations in ambient conditions in order to attenuate formatting variations caused thereby appears obvious.

The subject-matter of claim 7 can therefore not be considered as involving an inventive step (Article 33(3) PCT).

2.6 As for the formatters stipulated in claims 8-11 and the optical media stipulated in claims 14-17 the additional features are considered either implicitly disclosed by D2 or rendered obvious by a combination of the disclosure of D2 with the teaching of D1.

The subject-matter of claim 8-11 and 14-17 can therefore not be considered as involving an inventive step (Article 33(3) PCT).

2.7 As for claim 20 D2 further discloses :
a tracking and formatting system for tracking data stored in a 3D formatted monolithic optical medium, said tracking and formatting system comprising:
an optical unit (D2 fig. 4a EL and El1 - El3 page 4 line 23 - page 5 line 5) adapted to focus at least two laser beams of possibly mutually different wavelengths at respective points in the optical medium having a controlled mutual displacement, so as to form a read spot that is used to obtain a read signal from the optical medium and a write spot that is used for recording registration marks for enabling data to be written to or read from a desired location in the optical medium, said registration marks being arranged in at least one base layer formed within a bulk of the optical medium displaced from an. outer surface thereof,
a non-position sensitive detection unit (D2 whole document 'lecture optique d'information') coupled to the tracking unit and being responsive to the tracking signal. generated thereby for reading data marks stored in
data layers of said optical medium independent of a spatial structure of the detection unit, and
a tracking unit for (D2 whole document 'suivi de piste') generating a. tracking signal that conforms to the formatting pattern in said formatted optical medium to enable calculation of a tracking error S signal that is used as feedback for servo-mechanisms

that control the precise location of a read spot according to said formatting pattern, said tracking unit being responsive to the read spot for tracking an information track in a layer that is at least partially recorded and/or servo marked (see also paragraph 2.1 above).

The subject-matter of claim 20 is therefore not new in the sense of Article 33(2) PCT.

2.8 The further formatting systems defined in dependent claims 21-36 are not new resp. inventive with respect to the record carriers, formats, formatters and tracking/formatting systems shown in D1 (see the description relating to record carrier in fig. 22 and formats in figs. 15A -21 and figs. 23A- 23B) or D2 (see above paragraphs 2.7). These claims merely define straightforward embodiments and possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem posed. Most of the additional features are disclosed or suggested by the prior art at hand. Moreover, the description does not disclose what specific advantages these additional features might imply. Therefore, these claims add nothing inventive. Finally, the dependent claims are obviously not linked by one single general inventive concept (Rule 13 PCT).In particular it has to be noted that:
- the tracking-error signal extraction from the known burst marks defined in claims 26 and 28 is already described in document D5 (cited in the present application) for said marks; hence, the subject-matter of dependent claims 26 and 28 merely reflects an obvious standard and is not inventive.

Re Item VII
Certain defects in the international application

1. Independent claims 1, 6, 7, 20 are not drafted in the two part form specified in Rule 6.3b) of the PCT.

2. Reference numerals are missing after the technical features of the claims (see Rule 6.2b) and PCI Preliminary Examination Guidelines, Chapter III, 4.11).

that creates a tilted mark is the addition of a liquid crystal panel that blocks approximately two thirds of one half of the clear aperture of the optical unit focusing the recording beam. In Fig. 11 the track is drawn from a tangential view (track going into the page). The two partially overlapping ellipses indicate the two orientations of servo marks that are tilted relative to this track. If the reading spot 1110 drifts along one of two diagonal directions, along the orientation of the marks, then the signal from one servo marks sequence become weaker much faster than the signal from the other servo marks sequence. The information is not complete, as it does not indicate in which direction along the mark was the relative movement of the spot. The missing information is added by either adding servo marks that have other deformations or by combining these methods with other tracking methods, such as those of the first family of the second approach for achieving the tracking and formatting. An embodiment of tracking with complete information is illustrated in Fig. 10, where an additional pair of servo marks is used (1030, 1040), that are tilted in the tangential direction. These marks enable derivation of an error signal in the axial direction, substantially having every servo mark play the role of two axial i.e. non-tilted servo marks of the first family of the second approach to formatting and tracking, thus completing the information. The use of the tangentially tilted marks has the benefit of one simple scheme for all servo marks but requires more accurate timing of the sampling of the tangentially tilted mark to ensure that comparison is indeed between the first part of the mark that is below (or above) the track and the second part that is on the other side. Methods for creating tilted beam profiles are discussed in the detailed description of the invention and include partial, asymmetrical, obscuration of the objective or the creation of aberrations e.g. comma aberrations by tilting one of the optical elements.

It will be understood that the preferred implementations of the second approach described in the detailed description are also non-limiting and the sampled servo signaling may or may not have dedicated track intervals. If the sampled servo has dedicated intervals, these intervals can be of constant linear length, of constant angular length or even of varying lengths. A continuous data sequence may be recorded using continuous servo information from adjacent servo tracks in the radial and axial directions. The servo signaling marks can additionally be encoded by varying the location or density of the marks, either by varying the location along the track or by

are circular in nature. The nature of the formatting of the media allows the extraction both tracking information and additional track data such as sector number and zone. Said servo signals are recorded in a multi-burst pattern that allows the extraction of fractional radial track error signal and the calibrated and controlled fractional track following.

US Patent No. 6,091,697 (Le Carvennec, *et al.*) corresponding to WO 97/23872 assigned to Thomson CSF and entitled "*Optical recording medium having a plurality of recording layers*" discloses optical information recording/reading medium including at least one transparent layer for recording or reading information in various strata distributed through the thickness of the medium. The medium includes, recorded in a principal plane at least the transparent layer with one or more information items for carrying out either tracking, focusing, synchronization or addressing or any combination. Also included in each stratum is one more guidance information items. A registration layer is formed on the outer surface of the recording medium.

EP 0461956 also assigned to Thomson CSF and entitled "*Optical information storage on superimposed layers*" discloses a system for optical storage of information. The information is stored within the volume of a transparent layer instead of being stored at the surface. Sequences of different information are stored in different strata of the layer. The means of writing and of reading are designed to focus a light beam in the plane of a specified stratum without focusing it on the others. Photodetectors permit selective detection of the beam perturbations engendered by each of the respective individual strata. The material of the transparent layer is preferably a material with photoinduced index variation.

US Patent No. 6,574,174 (Amble *et al.*) entitled "*Optical data storage system with multiple layer media*" discloses an optical information storage system using optical storage media including multiple data layers or stacks wherein each of the multiple data stacks has a storage density comparable to a conventional single layer optical disk. The optical data storage system comprises an optical medium having a single dedicated servo layer and multiple data stacks which each contain an embedded servo format, a servo laser beam positioned to maintain a first focus point on the dedicated servo reference layer, a read-write laser beam positioned to maintain a second focus point on one of the data stacks, a first, dedicated servo system which provides focus and tracking error correction according to error signals generated from the dedicated servo layer, and a

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second, embedded servo system which provides focus and tracking error correction according to error signals generated from the data stacks. The dedicated servo layer, in different embodiments of the invention, may be positioned either below or above the data stacks in the optical medium, or interposed between data stacks. The data stacks may comprise discrete physical data layers or "virtual" data layers defined by a format hologram. The servo and read-write lasers may differ in wavelength and/or polarization.

WO 98/25268 (Glushko) entitled "*Fluorescent Optical Memory*" discloses a method of manufacturing a fluorescent 3-D optical memory device implementing an active medium capable of storing information at high information density, and an optical memory device manufactured by this method. To this end there are applied suitable fluorescent layers so that the medium is not monolithic.

In magnetic media, it is customary that higher level formatting of the device is performed at the end user location under the control of the computing system that uses the magnetic storage device. This gives the computing system a lot of space for optimizing the formatting according to the computing system unique requirements, one example is the ability to divide one magnetic hard disc into few partitions where one part is used by one Operating System (OS) and the other is used by another OS. The different parts are usually readable only by the appropriate OS. The formatting of the disc can be divided into different layers of format. The low level formatting of the disc is common to both OS in this example while the higher level formatting into an ordered file system is the part unique to each OS.

Formatting enables, among other things:

- an agreed upon organization of the data in the medium;
- finding and reading the logical and physical location of the basic data units (data blocks, sectors, block clusters);
- recording data in accurately documented and retrievable locations;
- tracking the data and tuning to a defined location where the data is stored for data retrieval, tracking (see for example USSN 10/096,369 filed March 13, 2002 and entitled "*Method for tracking data in an optical storage medium*" in the name of the present assignee), inscription of Adaptive Gain Control and synchronization headers, and more;
- encompassing system information in the media e.g. disc type and model, sensitivity, density of recording, manufacturing information and Individual ID and tags;
- tuning the reading and or recording device parameters to the medium, e.g. changing laser power in DVD-R according to different media;
- encompassing file system and files at different levels of security and visibility (to the different users);

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denoted by d2 is 160 micron. Fig. 3c illustrates the structure of the formatted disc by looking at the center of the disc. The distance, in the center of the disc, between the first spiral base layer of the first half of the disc and its counter rotating pair is denoted by d3. In the embodiment shown in the figure, d3 is 40 microns and the total disc thickness is 6 mm. In a preferred embodiment the base layers include test areas to validate that there is no over-writing of the base layers.

Fig. 4 shows schematically tracking and writing a new layer to a formatted disc according to a first approach. The optical unit that is modeled as a focusing lens, for the sake of explanation only, focuses two beams of different wavelengths at different depths of the disc, separated by a distance d4. The reading spot 401 tracks a spiral that is already inscribed at a certain depth in a layer whose plane is indicated by a dashed line 402, this spiral track serving as a master. At the same time, a writing spot 403 inscribes a new spiral separated by d4 from the reading spot in the vertical direction, but having the same location along the other axes as the master.

Figs. 5a and 5b are schematic representations showing a simplified 2D view of the sampled servo technique of a second formatting method. Fig. 5a illustrates the method of extracting tracking error signal from a single track. The location of the track that is allocated for data is indicated by dashed intervals and dotted intervals indicate the locations allocated for the servo marks. Servo marks, that are the marks inscribed at the formatting step, are offset to the nominal track location, so that as the reading spot passes along the nominal track a tracking signal is collected from the servo marks. The signal is proportional, linearly or non-linearly to the overlap between the read spot and the servo marks. If the reading spot is exactly centered on the nominal track location, then the overlap with the servo marks offset to the sides of the tracks is the same and the difference between the signal obtained from a sequence of servo marks is zero. If the reading spot is nominally offset to the track, then the filtered signal from a first sequence of marks will be different from the signal from the second sequence of marks, located on the other side of the track and this difference will serve as tracking error signal, indicating the direction in which the reading spot should be moved.

Fig. 5b illustrates the use of alternating servo in the simplified 2D scheme on a patch of ten tracks t1,..., t10. The direction of reading spot scan is from left to right along the page, the servo marks of the odd numbered tracks having the left indicating servo

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CLAIMS:

1. A formatted optical medium having a formatting pattern including registration marks for enabling data to be written to or read from a desired location in a monolithic bulk of the optical medium, said registration marks being arranged in at least one base layer;

characterized in that:

the at least one base layer is formed within a bulk of the optical medium displaced from an outer surface thereof.

2. The formatted optical medium according to claim 1, wherein, in use, the at least one base layer serves as a guide for writing data at respective data layers in the medium associated with the at least one base layer without requiring pre-formatting of said data layers.

3. The formatted optical medium according to claim 1 or 2, wherein respective registration marks are contained in multiple base layers all formed within a bulk of the optical medium displaced from an outer surface thereof, such that adjacent base layers have a known mutual separation and each base layer, in use, serves as a guide for writing data at respective multiple data layers in the medium associated with the respective base layers.

4. The formatted optical medium according to any one of claims 1 to 3, wherein the registration marks are angularly tilted.

5. The formatted optical medium according to any one of claims 1 to 4, wherein the registration marks are of controlled size and length.

6. A method for writing data to M multiple layers all associated with a common base layer in the formatted optical medium according to any one of claims 1 to 5 using a write spot that is spatially offset from a read spot by a controlled offset, said method comprising:

focusing the reading head in controlled registration with the common base layer and writing data to a first data layer ($L = 1$) of said data layers so as to be displaced from the common base layer by said fixed offset; and

for each subsequent data layer L ($2 \leq L \leq M$), focusing the reading head in controlled registration with a previous data layer ($L - 1$) and writing data to said data

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layer (L) so as to be displaced from the previous data layer (L - 1) by said controlled offset.

7. A formatter for inscription of marks on to a monolithic 3D translucent optical medium to enable recording and retrieval of information in the medium, , the formatter comprising:

at least one optical unit calibrated to focus at least one diffraction limited spot within the medium at a respective depth therein displaced from an outer surface thereof,

at least one light source optimized for the inscription of marks including registration marks that enable data to be written to or read from a desired location in the optical medium, said registration marks being arranged in at least one base layer formed within a bulk of the optical medium displaced from an outer surface thereof displaced from an outer surface thereof,

at least one actuator for moving said at least one diffraction limited spot relative to the medium, and

a controller for controlling fluctuations in ambient conditions in order to attenuate formatting variations caused thereby.

8. The formatter according to claim 7, wherein the medium is disc shaped and the motion of the spot relative to the medium is via rotation of the disc and motion of the optical unit.

9. The formatter according to claim 7 to 8, wherein the optical unit includes a beam splitting mechanism for splitting the beam whereby a plurality of oblong marks are inscribed simultaneously.

10. The formatter according to claim 7, wherein the optical unit is an assembly including a plurality of accurately calibrated optical units each being focused at a different depths and relative movement between the assembly and the media inscribes a multitude of tracks simultaneously.

11. The formatter according to any one of claims 7 to 10, further including a clamping unit for holding a stack of disks in precise mutual spatial disposition, to be accessed by a multitude of optical units and actuated by a multitude of actuators.

12. The formatter according to any one of claims 7 to 11, wherein the registration marks are angularly tilted.

13. The formatter according to any one of claims 7 to 12, wherein the registration marks are of controlled size and length.

14. A formatted 3D translucent monolithic optical medium having a formatting pattern that is generated by a formatter according to any one of claims 7 to 13 so as to allow information to be recorded and read back without requiring that the medium have a physically layered structure.

15. The formatted optical medium according to claim 14, wherein discrete servo offsets in 3D or a continuous range of servo offsets in 3D, are used to obtain a 3D tracking error signal.

16. The formatted optical medium according to claims 14 or 15, wherein the formatting pattern comprises zoned spirals or circles in which sectors and headers are encoded.

17. The formatted optical medium according to any one of claims 14 to 16, having an arrangement of alternating oblong servo marks that define tracks in adjacent virtual layers such that the servo marks arrangement is equivalent to a triplet or a quadruple of servo indicators and such that the count of indicators is equal to the number of tracks intervals.

18. The formatted optical medium according to any one of claims 14 to 17, wherein the registration marks are angularly tilted.

19. The formatted optical medium according to any one of claims 14 to 18, wherein the registration marks are of controlled size and length.

20. A tracking and formatting system for tracking data stored in a 3D formatted monolithic optical medium, said tracking and formatting system comprising:

an optical unit adapted to focus at least two laser beams of possibly mutually different wavelengths at respective points in the optical medium having a controlled mutual displacement, so as to form a read spot that is used to obtain a read signal from the optical medium and a write spot that is used for recording registration marks for enabling data to be written to or read from a desired location in the optical medium, said registration marks being arranged in at least one base layer formed within a bulk of the optical medium displaced from an outer surface thereof,

a non-position sensitive detection unit coupled to the tracking unit and being responsive to the tracking signal generated thereby for reading data marks stored in

data layers of said optical medium independent of a spatial structure of the detection unit, and

a tracking unit for generating a tracking signal that conforms to the formatting pattern in said 3D formatted optical medium to enable calculation of a tracking error signal that is used as feedback for servo-mechanisms that control the precise location of a read spot according to said formatting pattern, said tracking unit being responsive to the read spot for tracking an information track in a layer that is at least partially recorded and/or servo marked.

21. The tracking and formatting system according to claim 20, further comprising:

a plurality of at least partially recorded base layers having a known mutual separation; and

an optical unit enabling data to be read with one wavelength and data recording with another wavelength.

22. The tracking and formatting system according to claim 21, wherein the base layers include test areas to validate that there is no over-writing of the base layers.

23. The tracking and formatting system according to claim 20, wherein the registration marks are arranged in a plurality of discrete offsets or a continuous range of radial, axial or angular offsets.

24. The tracking and formatting system according to claim 20, wherein said registration marks and the data marks are of different sizes and lengths.

25. The tracking and formatting system according to any one of claims 20 to 24, wherein:

the formatting pattern comprises a multitude of intervals along each data track, each of said intervals having a respective type that indicates a property of the data associated with the interval.

26. The tracking and formatting system according to any one of claims 20 to 24, wherein any variations in the fixed offset between the read and write spots is corrected by tracking error signals of the form:

$$\frac{(A \cdot S1 - S2) - B}{D \cdot (E \cdot S1 + S2)}$$

where:

S1 and S2 are the respective signal amplitudes from the two offset mark sequences;

A and B are symmetry breaking factors; and

$D\cdot(E\cdot S1+S2)$ is a general normalization factor.

27. The tracking and formatting system according to any one of claims 20 to 26, wherein two pairs of servo offset marks are used in each axis to obtain servo indication.

28. The tracking and formatting system according to claim 27, wherein the servo offsets include servo offsets of two different magnitudes and any variations in the fixed offset between the read and write spots is corrected by a track error signal of the form:

$$\frac{A\cdot(B\cdot S1-S2)+C\cdot(D\cdot S3-S4)}{I\cdot\left(E\cdot(S1+F\cdot S2)+G(S1+H\cdot S2)\right)}$$

where:

S1, S2, S3 and S4 are the respective signal amplitudes of the four offset mark sequences;

A, B, C and D are symmetry breaking factors; and

$I\cdot\left(E\cdot(S1+F\cdot S2)+G(S1+H\cdot S2)\right)$ is a general normalization factor.

29. The tracking and formatting system according to claim 25, wherein said intervals include two types relating respectively to user data and to servo and system information.

30. The tracking and formatting system according to claim 25, wherein said intervals include two types of intervals having respective zoned constant linear lengths a first being dedicated mostly to user data and a second being dedicated mostly to servo and system information.

31. The tracking and formatting system according to claim 25, wherein said intervals include two types of intervals having respective zoned constant angular lengths a first being dedicated mostly to user data and a second being dedicated mostly to servo and system information.

32. The tracking and formatting system according to any one of claims 29 to 31, wherein the intervals have a pseudo-random variation of length.

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33. The tracking and formatting system according to any one of claims 20 to 32, wherein the formatting pattern comprises zoned spirals or circles in which sectors and headers are encoded.

34. The tracking and formatting system according to any one of claims 20 to 33, having an arrangement of alternating registration marks that define data tracks in adjacent virtual layers such that the registration marks arrangement is equivalent to a triplet or a quadruple of servo indicators and such that the count of indicators is equal to the number of data tracks intervals.

35. The tracking and formatting system according to any one of claims 20 to 34, wherein the formatting pattern encodes auxiliary information in addition to nominal track center.

36. The tracking and formatting system according to any one of claims 20 to 35, being adapted for recording content in the course of the formatting process.

37. The tracking and formatting system according to any one of claims 20 to 36, wherein the registration marks are angularly tilted.

38. The tracking and formatting system according to any one of claims 20 to 37, wherein the registration marks are of controlled size and length.